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GIN SEED-ROLL DENSITY AND ITS EFFECT ON THE SPINNING QUALITY OF COTTON

By

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INTRODUCTION

The tremendous increase in the demand for cotton of good quality imposed by war requirements emphasizes the need for improving ginning methods. By adopting the best practices, ginners can make a definite improvement in the grades of cotton produced. One grade quality factor in particular that can be improved in that way is the ginning preparation, or the smoothness of the ginned lint.

Estimates made by the Food Distribution Administration indicate that 7.2 percent, or about 756,000 bales, of the cotton crop of 1941 was roughly ginned or reduced in quality by one grade or more on account of rough ginning preparation. In addition to these reported reductions of one grade or more in quality, a considerable part of the crop placed in the category of normal preparation was ginned slightly rough, and sometimes noticeably so, but was not damaged enough to be reduced a full grade.

Rough ginning preparation is caused by ginning cotton that contains excess moisture, or by the use of dense seed rolls. Cotton is likely to be rough in preparation during the early part of the season when it is harvested in a green and damp condition, and at any time during the season when there are rains or heavy dews. The other principal cause of rough preparation is the ginning of cotton with dense seed rolls. This is usually the result of one of three factors: (1) overfeeding of cotton to gin stands in order to obtain maximum capacity; (2) restricting the passage of the ginned seed from the seed-roll boxes of the gin stands to increase the gin turn-out; or (3) ginning on machines that are badly run down and in need of repair or replacement parts that are vital to good ginning 1/.

A recent study of the ginning operations of more than 500 commercial gins in the Cotton Belt from the Carolinas to Arizona revealed that more than one-third of the gins were being operated with dense or medium to tight seed rolls at the time they were checked by a representative of the U. S. Cotton Ginning Laboratory. In 60 percent of these gins, the seed boards were set to restrict to some degree the passage of the ginned seed from the seed-roll box in an effort to clean the seed better and to increase the gin turn-out. This practice, however, caused the seed rolls in half of the gins so operated to be increased enough in density to have an unfavorable effect on the preparation of the ginned lint. In the gins that were operated with the seed boards set wide open, and that constituted 40 percent of the gins checked, one-third were fed beyond normal capacity, and therefore employed seed rolls dense enough to cause rough ginning preparation. Of all the gins checked, 9 percent were operating with dense seed rolls simply because of feeding beyond normal capacity, and 29 percent because of restricting the passage of the seed from the seed-roll box and feeding at too high a rate in relation to the seed board setting.

1/ The causes of rough ginning are discussed fully in the following publications: Bennett, Charles A., and Gerdes, Francis L., Effects of Gin-Saw Speed and Seed-Roll Density on Quality of Cotton Lint and on Operation of Gin Stands, U. S. Dept. of Agr. Tech. Bul. No. 503; Gerdes, Francis L., and Bennett, Charles A., Effect of Artificially Drying Seed Cotton Before Ginning on Certain Quality Elements of Lint and Seed and on Operation of the Gin Stand, U. S. Dept. of Agr. Tech. Bul. No. 508; Bennett, Charles A., and Gerdes, Francis L., Care and Maintenance of Cotton-Gin Saws and Ribs, U. S. Dept. of Agr. Cir. No. 393; Stedronsky, Victor L., and Johnson, Arvid J., Care and Repair of Cotton-Gin Brushes, U. S. Dept. of Agr. Cir. No. 467; and Johnson, Arvid J., and Baggette, Thomas L., Air-Blast Gin Performance and Maintenance, U. S. Dept. of Agr. Cir. No. 510.

Studies of the effects on spinning quality of different densities of seed roll employed in ginning cotton have been made over a period of years at the Department's Cotton Testing Laboratory at Clemson, S. C. These studies were made on cottons ginned at the U. S. Cotton Ginning Laboratory, Stoneville, Miss., in connection with the program of cotton ginning investigations 2/. As previously indicated, much of the roughly ginned cotton is caused by ginning cotton with dense seed rolls, produced by heavy feeding of cotton to the gin stand, or by restricting the passage of the ginned seed by the seed-roll box of the gin stand. By the latter method, known as "close" ginning, an unusual quantity of the short fibers on the seed are removed by the gin saws and passed on with the ginned lint to lower the quality of the lint. It was the purpose of the spinning tests to determine the ultimate effects of this rough ginning preparation on the quality of the yarn, together with its effects on manufacturing waste.

TEST PROCEDURE

Ginning

Because much of the rough ginning in the United States is caused by heavy gin feeding, the spinning tests reported in this study were made on cotton ginned with tight seed rolls caused by heavy feeding, for comparison with cotton ginned with loose seed rolls produced by normal feeding to 70-saw gin stands. Eight cottons, varying in staple length from 31/32 inch to 1-3/16 inches and in grade from Strict Low Middling to Middling, were ginned by these two methods, and the resulting lint was spun into carded warp yarns of three counts, namely, 22s, 50s, and 60s. Following these studies additional tests were made on comparative lots ginned with tight seed rolls obtained by the use of a closed seed board for comparison with lots ginned with an open seed board. The lint samples ginned by these two methods from seven cottons ranging in staple length from 1 inch to 1-1/8 inches, and from Strict Low Middling to Strict Middling in grade were also subjected to spinning tests. Yarn counts included 22s, 44s, and 60s carded warp.

2/ The experimental ginning program is being conducted jointly by the Bureau of Plant Industry, Soils, and Agricultural Engineering and the Food Distribution Administration, in cooperation with the Delta Branch Experiment Station, Stoneville, Miss.; the experimental spinning program is being conducted at the cooperative testing laboratories at the Clemson Agricultural College, Clemson, S. C., and the A. & M. College of Texas, College Station, Tex. Acknowledgments are made to co-workers of the U. S. Cotton Ginning Laboratory for assistance in providing the material through regular ginning activities and to co-workers of the Cotton Testing Laboratory, under the supervision of John M. Cook, Associate Cotton Technologist, for the spinning results reported.

During the ginning of all cottons, data on ginning time, turn-out, and other factors were recorded. The ginned lint samples were classed by Government classers according to the official cotton standards, and were tested for moisture content, length, and length uniformity.

Spinning

At the spinning laboratory the samples were spun and tested according to the usual practice in this laboratory for lots weighing from 30 to 50 pounds. Determinations of picker and card waste were made during the tests, and as the material passed through the various machines, observations were made of any outstanding characteristics that might be associated with cottons ginned by the different methods. The carded warp yarns ranging in size from 22s to 60s were tested for skein strength, and yarn appearance was determined by grading samples of the yarns against the yarn appearance standards developed in the Department's laboratories.

RESULTS OF THE GINNING AND SPINNING TESTS

The averages of the results of the cotton ginning and spinning tests are presented in table 1 for the group of tests involving tight seed rolls produced by heavy feeding, and in table 2 for the group of tests including the tight seed rolls obtained with a closed seed board. Charts of the results are shown in figures 1 and 2 for the ginning and spinning tests, respectively.

The statistical significance of the differences between the averages for the loose roll and those for the tight roll were calculated in each group, and the degrees of significance were determined for these values. Odds within the range of 19 to 1 and 99 to 1 are considered significant and are denoted by one asterisk (*) accompanying the difference figures presented in succeeding charts. Odds above 99 to 1 are considered highly significant and are denoted by two asterisks (**).

Effect of Tight Seed Rolls on Ginning Qualities of the Cotton

As compared with the loose seed roll, the tight seed roll produced by heavy feeding of the cotton to the gin stands reduced the average ginning time more than 20 percent, but the tight seed roll obtained with the closed seed board gave the same average ginning time as the loose seed roll in ginning the same cottons (tables 1 and 2, and figure 1). The tight seed rolls obtained by the former method had very little effect on lint turn-out, but those produced by holding the seed in the roll box longer than usual caused enough close ginning to increase the bale weight an average of 22 pounds as compared with loose-roll

Table 1. - Average ginning and spinning quality effects associated with tight seed-roll ginnings resulting from heavy feeding of cotton to gin stands (Average of data for 8 cottons ranging in length from 31/32 inch to 1-3/16 inches)

Ginning factors and lint quality elements	Loose seed-roll ginning by normal feeding of cotton to gin stands	Tight seed-roll ginning by fast feeding of cotton to gin stands	Difference, based on loose seed-roll ginning
Ginning time per bale 1/, minutes	52.9	41.0	- 11.9
Bale weight, pounds	480	483	+ 3
Grade, code points 2/	5.3	5.9	- 0.6
Staple length, 1/32 inch	34.8	34.6	- 0.2
Upper quartile length, inches	1.12	1.12	0.0
Length variability, percent	36.2	35.0	- 1.2
Picker and card waste, percent	7.7	8.3	+ 0.6
Yarn strength index, percent	94.5	94.4	- 0.1
Appearance grade of 22s yarns, code points 3/	4.0	4.2	- 0.2

1/ For 1,500 pounds of seed cotton ginned on a 70-saw gin stand.
2/ The indexes used for grade designation are 5 for Middling and 6 for Strict Low Middling, with the decimals denoting proportionate fractions of grades.
3/ The indexes used for yarn appearance grade designation are 4 for B+ and 5 for B, with the decimals denoting proportionate fractions of grade steps from one designation to another.

Table 2. - Average ginning and spinning quality effects associated with tight seed-roll ginnings resulting from restricting the passage of the seed from the seed-roll boxes of the gin stands (Average of data for 7 cottons ranging in length from 1 inch to 1-1/8 inches)

Ginning factors and lint quality elements	Loose seed-roll ginning by normal feeding of cotton to gin stands	Tight seed-roll ginning by restricting the passage of the seed from the gin seed-roll boxes	Difference, based on loose seed-roll ginning
Ginning time per bale 1/, minutes	59.3	60.0	+ 0.7
Bale weight, pounds	546	568	+ 22.0
Grade, code points 2/	4.6	5.5	- 0.9
Staple length, inches	34.1	33.9	- 0.2
Upper quartile length, inches	1.11	1.10	- 0.01
Length variability, percent	31.4	33.1	+ 1.7
Picker and card waste, percent	6.4	7.4	+ 1.0
Yarn strength index, percent	102.2	99.1	- 3.1
Appearance grade of 22s yarns, code points 3/	4.3	4.9	- 0.6

1/ For 1,500 pounds of seed cotton ginned on a 70-saw gin stand.
2/ The indexes used for grade designation are 5 for Middling and 6 for Strict Low Middling, with the decimals denoting proportionate fractions of grades.
3/ The indexes used for yarn appearance grade designation are 4 for B+ and 5 for B, with the decimals denoting proportionate fractions of grade steps from one designation to another.

ginning. This increased turn-out of shorter length fiber caused the length variability to be increased slightly, while in the case of the tight seed rolls which were produced by heavy feeding and which only increased the bale weight 3 pounds, the average length variability was not significantly different from that for the loose seed-roll samples. Length, as determined both by the classer and by laboratory tests, was not noticeably affected by the tight seed rolls obtained by the two methods described.

The tight seed roll that caused close ginning lowered the grade of the samples more than the tight seed roll produced by heavy feeding, the respective grade reductions being almost one full grade and about 1/2 grade. In the light of the results previously discussed, the increased fiber turn-out associated with close ginning had a more pronounced effect on grade than on staple length.

Effect of Tight Seed Rolls on the Spinning Qualities of the Cotton

The total picker and card waste removed in the spinning tests of lots ginned with tight seed rolls produced by heavy feeding averaged about 1/2 percent higher than that of the lots from similar cottons ginned with loose seed rolls (tables 1 and 2, and figure 2). The tight seed rolls obtained by close ginning, however, increased this waste 1 percent as compared with loose-roll ginning on the same cottons. While this tight seed roll, which was obtained by restricting the passage of the seed from the seed-roll box, increased bale weight about 4 percent, on the average, as compared with loose seed-roll ginning, manufacturing waste was, on an average, only 1 percent higher with these lots than with the lots ginned with loose seed rolls.

In order to simplify the handling of the yarn strength data from each count of yarn for each lot spun, the yarn strengths have been converted to indexes. (An index of 100 means that the strength of a yarn is equal to the average for that count and staple length obtained for a large number of cottons in the spinning laboratories of the Food Distribution Administration.) The indexes for the three counts have been averaged, and a grand average computed for all the cottons representing one type of gin treatment. Thus, a comparison of the average indexes in table 2 shows the percentage differences in yarn strength attributable to the gin treatment.

Comparing the average yarn strength indexes in tables 1 and 2, it is seen that the important element of yarn strength was not materially affected by the rate of feeding at the gin. In the case of the seed board adjustment, however, it was found that cotton ginned with the closed board resulted in yarn of definitely inferior strength, that is to say, close ginning reduced the average yarn strength of the seven cottons about 3 percent.

The appearance grades of the 22s yarns indicated no real or consistent differences with respect to this quality in the case of the heavy and light feedings. On the other hand, the appearance grades for yarns from closed and open seed-board ginning showed that the close ginning significantly impaired the appearance of the yarn as compared with open seed-board ginning.

SUMMARY

Ginnings were made on eight cottons, ranging in staple length from 31/32 inch to 1-3/16 inches, by use of standard loose seed rolls produced by normal feeding of cotton to gin stands, and by use of tight seed rolls obtained by heavy feeding. The purpose was to ascertain the effects of dense seed rolls so obtained on the spinning quality of the ginned lint. Tight seed-roll ginnings were also made on seven other cottons, ranging in staple length from 1 inch to 1-1/8 inches, by close ginnings produced by restricting the passage of the seed from the seed-roll boxes of the gin stands, and by employing normal feeding. Corresponding lots from these cottons were ginned with loose seed rolls to provide comparative material.

As compared with averages for loose seed-roll ginning, tight seed-roll ginning produced by fast feeding decreased ginning time over 20 percent, had very little effect on lint turn-out, reduced the quality of the lint by about one-half grade, but had no real effect on the fiber length. The tight roll, close ginning, however, added short fiber to the lint. This was reflected in a 4 percent increase in bale weight and a higher fiber length variability. An average grade damage of almost one full grade was also found when the tight roll, close ginning method was used. Ginnings made with this type of dense seed toll gave the same average ginning time as those made with loose seed rolls on the same cottons.

The increased damage to lint quality produced by close ginning over that produced by heavy feeding was reflected in increased manufacturing waste and in a greater reduction in yarn strength. As compared with loose seed-roll ginning, tight seed-roll close ginning increased manufacturing waste 1 percent, while tight seed-rolls resulting from heavy feeding increased it 0.5 percent. Also, the tight seed-roll close ginning method significantly reduced yarn strength and appearance, whereas no real effects on these quality elements were noted with tight seed rolls resulting from fast feeding of the cotton to the gin stands.

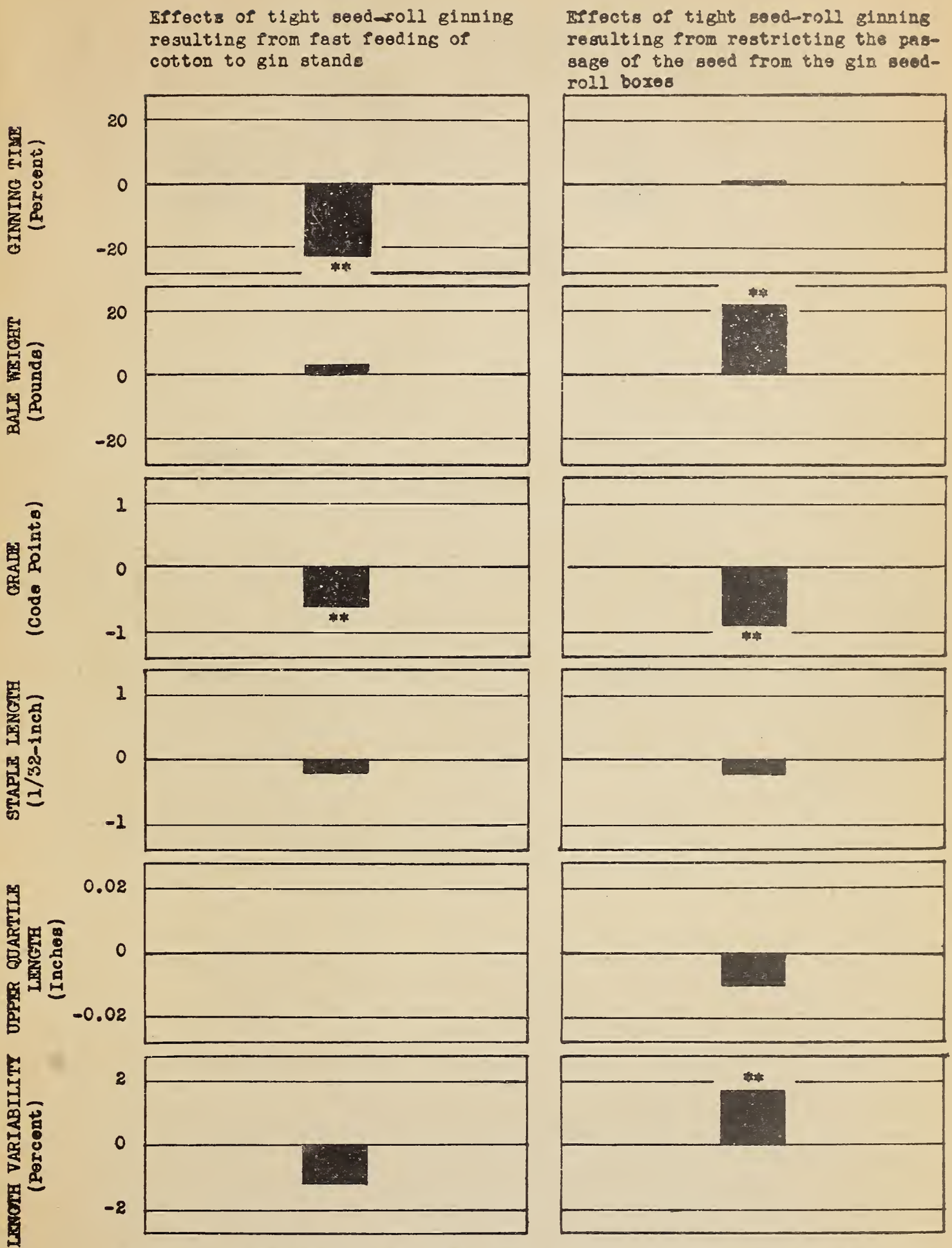

Figure 1. - Average of the differences in cotton ginning and lint-quality elements based on loose seed-roll ginnings of 8 cottons. Significant differences are denoted by one asterisk (*), and highly significant differences by two asterisks (**).

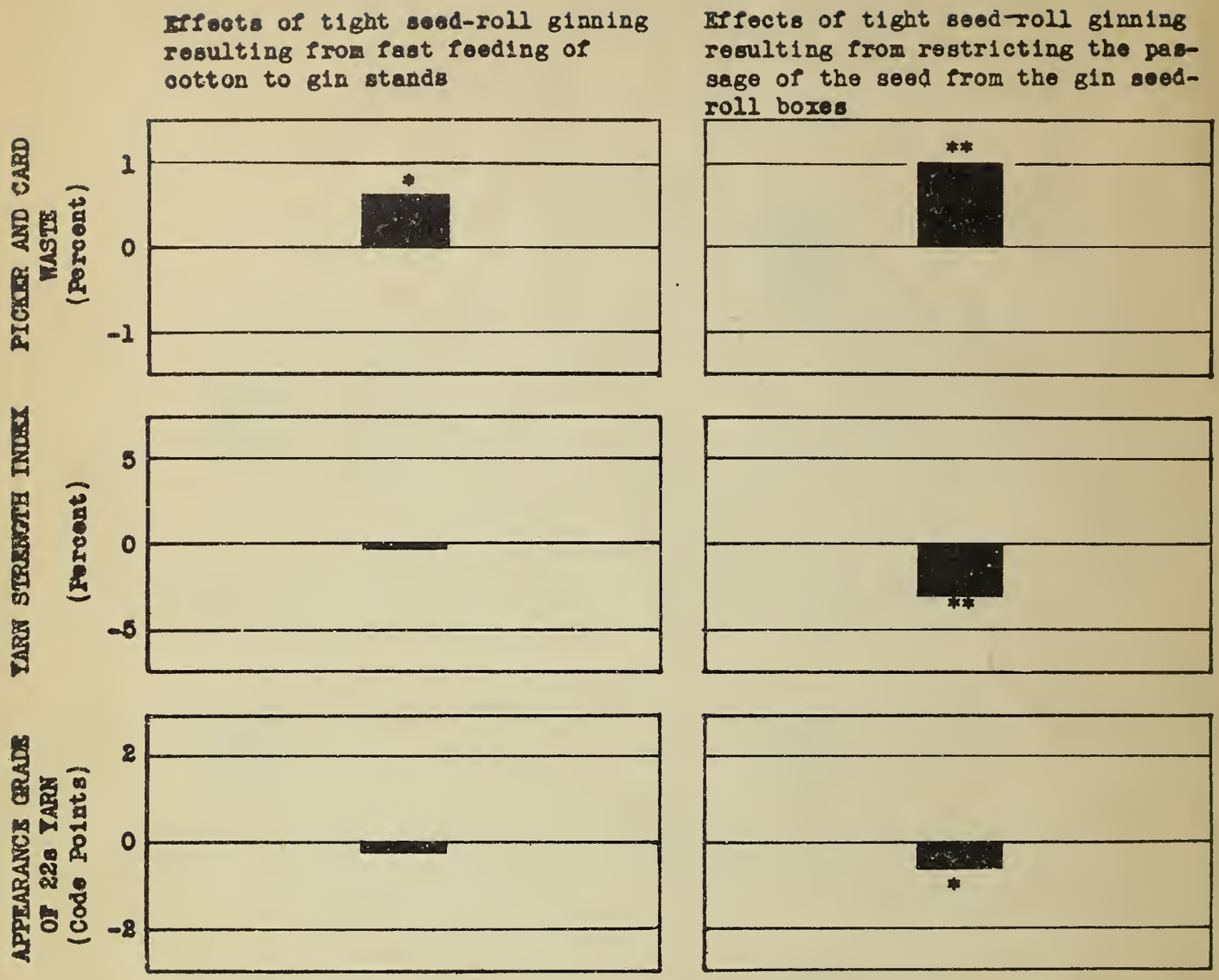

Figure 2. - Average of the differences in cotton spinning qualities of lint based on loose seed-roll ginnings of 7 cottons. Significant differences are denoted by one asterisk (*), and highly significant differences by two asterisks (**).